CASE STUDY: BIOMECHANICS

Plasma Research
University of Saskatchewan

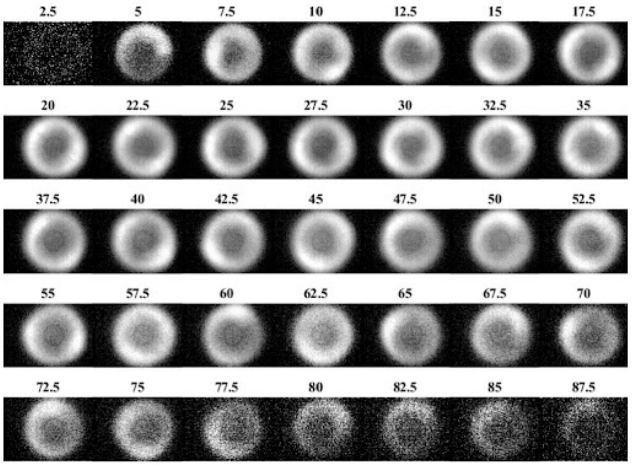
Case Highlights:

- **Customer:** University of Saskatchewan
- **Use Case:** Research & Development
- **Needs:** Observe plasma spokes
- **Challenge:** Extremely high speed event
- **Industry:** Engineering
- **Equipment Used:** Chronos 1.4 monochrome camera

Challenge:

Observing plasma spokes that form during a High-Power Impulse Magnetron discharge (HiPIMS) which evolve on a scale of microseconds and require a high-speed camera to capture.

The spokes are caused by instability in high-density magnetized plasmas, specifically, Hall effect thrusters and HiPIMS plasmas. It has been experimentally observed that the rate of diffusion of electrons across the magnetic field is higher than predicted, this discrepancy is known as the anomalous electron transport. It is believed that the spokes contribute to this but that they needed to be observed to validate the hypothesis.



Plasma Spokes
A set of Plasma Spokes formed during a High-Power Impulse Magnetron discharge (HiPIMS)

Customer
University of Saskatchewan

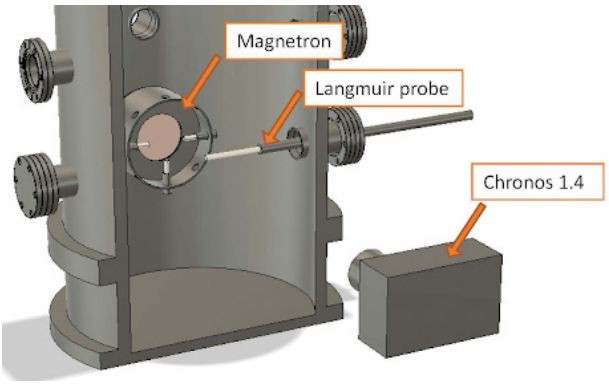
Use Case
Research and Development

Solution:

A Chronos 1.4 monochrome camera running at 15,941 frames per second was used to capture several frames per discharge.

Due to the extremely fast response of the magnetron discharge a variable delay circuit was developed to trigger the camera to capture thousands of images from different pulses of the magnetron but at the 'same' time relative to the start of the discharge. MATLAB was used to programmatically process each frame to identify the spokes.

This process let University of Saskatchewan study the spokes with a high degree of measurement. They were able to identify the number of spokes, the size of each spoke, and track how they evolved over time on average. This could not have been observed without a high-speed camera.



Experimental Setup Diagram
The versatiliy and ease-of-use of the Chronos 1.4 was ideal for quick set up and effective observation.

Setup

- Chronos 1.4 Camera (monochrome)
- 336 x 240 pixels
- Exposure time 1 µs
- 15,941 frames per second

Custom delay circuit
- Using a C4047 Chip

Computar Lens:
- 12.5-75mm zoom lens

Software:
- Matlab

Chronos 1.4 High-Speed Camera

Summary:

Scientific research and development, specifically in the areas of physics and engineering require precise measurement during experimentation. Chronos high-speed cameras provide the high-frame rates, resolution, and accessibility required by demanding labs today.

Learn more at www.krontech.ca.

Learn more about Alex Chang's thesis through his paper published by University of Saskatchewan:
https://harvest.usask.ca/handle/10388/13119

Check out the videos filmed with the Chronos 1.4 for this research, here